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IN THE UNITED STATES ~~PATENT~~ AND TRADEMARK OFFICE

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Inventor R.P. Shah
Assignee Johnson Matthey Electronics, Inc.
Group Art Unit 1753
Examiner S. Versteeg
Attorney's Docket No. 32120
Title: Tantalum-Comprising Articles (as amended)

DECLARATION OF RITESH P. SHAH, PH.D.

I, RITESH P. SHAH, declare as follows:

1. I am one of the named inventors in the above-identified application.

2. I have a Bachelor of Science Degree from M.S. University of Baroda, India; a M.S. Degree in Ceramic Science from New York State College of Ceramics, at Alfred University; and a Ph.D. in Metallurgy from the Georgia Institute of Technology.

3. I have read and am familiar with the Ohhashi et al. references (U.S. Patent No. 5,693,203; EP Application No. 0590504A1); Oikawa et al. (U.S. Patent 4,619,695); and the Wright et al. article cited by the Examiner against the claims in the present application.

4. I note that a difference between my claimed invention and the disclosures of the Examiner's cited references is that my invention is directed toward tantalum materials having substantially uniform (100) crystallographic orientation, and a maximum grain size less than 50 microns; whereas the cited references do not disclose any specific

1 tantalum materials having substantially uniform crystallographic orientation
2 and a maximum grain size less than 50 microns.

3 5. I have noted that the Ohhashi reference 5,693,203 discloses
4 tantalum materials, and also states that such materials have grain sizes
5 of no more than 350 microns. However, I further note that there is no
6 specific example in Ohhashi of a tantalum material having a grain size
7 less than 50 microns.

8 6. There are a number of advantages to reducing grain size in
9 tantalum materials. For instance, if the tantalum materials are utilized
10 as sputtering targets, smaller grain sizes can enable better uniformity to
11 be formed across a target surface. The better uniformity across the
12 target surface can improve uniformity of thin films deposited from the
13 target relative to thin films deposited from a target having larger grain
14 sizes. In other words, the quality of a thin film formed on a substrate
15 by a sputtering method can be influenced by the grain size of a target
16 material used for the sputtering, with smaller grain sizes leading to
17 improved qualities of sputter-deposited thin films. As an example of
18 how larger grain sizes can adversely influence sputter deposition, it is
19 noted that when protrusions of grain material are present on a sputtering
20 target surface, an abnormal discharge (so-called micro-arcing) can be
21 caused at the protrusions. The abnormal discharge can result in macro-
22 particles being scattered out from the surface of the target material, and
23 deposited onto a substrate along with a thin film that is intended to be

1 sputter-deposited on the substrate. The deposited macro-particles can
2 cause blobs on the thin film and result in short-circuiting of
3 semiconductor thin film circuits incorporating the sputter-deposited thin
4 films. The deposited macro-particles are known as "particles" or "splats"
5 in the art. An advantage of reducing crystal grain size is that a surface
6 roughness of a target material can be reduced by reducing grain size
7 within the target material. Accordingly, by reducing the size of crystal
8 grains existing within a target material, it is possible to prevent the
9 generation of "splats", thereby allowing better quality films to be formed
10 than can be formed from targets having larger grain sizes.

11 7. Of "critical" importance in my claimed invention is that the
12 claimed tantalum grain sizes are less than 50 microns. Grain sizes of
13 less than 50 microns can significantly improve surface properties of
14 articles formed from the tantalum materials, and specifically can improve
15 sputtering targets formed from the tantalum materials, relative to targets
16 formed from tantalum materials having larger grain sizes. My claimed
17 grain sizes of less than 50 microns can lead to substantially improved
18 targets relative to targets having larger grain sizes. There is no
19 indication in U.S. Patent 5,693,203 that a tantalum material was ever
20 produced having a grain size as low as 350 microns. Regardless, even
21 if a tantalum material were produced, my claimed invention is a
22 substantial improvement over such material in that my invention achieves
23 a grain size only one-seventh as large as the disclosed 350 microns,

1 specifically, my invention which is disclosed and claimed is to a tantalum
2 material having a grain size of 50 microns or less. For the reasons
3 described above, a tantalum material having a grain size of 50 microns
4 or less is significantly improved for forming particular tantalum articles,
5 such as, for example, sputtering targets, relative to tantalum materials
6 having larger grain sizes.

7 8. I have noted that European patent application 0590904A1 to
8 Ohhashi describes subject matter similar to the above described U.S.
9 patent, 5,693,203; but refers to targets having grain sizes less than 100
10 microns (claim 12). There is no indication in EP 0590904A1 that a
11 tantalum material was ever produced having a grain size as low as 100
12 microns. Regardless, even if a tantalum material were produced with a
13 grain size as low as 100 microns, my claimed invention is a substantial
14 improvement over such material in that my invention achieves a grain
15 size only half as large as the disclosed 100 microns, specifically, my
16 invention which is disclosed and claimed is to a tantalum material having
17 a grain size of 50 microns or less. For the reasons described above, a
18 tantalum material having a grain size of 50 microns or less is
19 significantly improved for forming particular tantalum articles, such as,
20 for example, sputtering targets. Therefore my claimed materials has
21 substantially improved properties relative to tantalum materials having
22 grain sizes even as low as 100 microns.

23

9. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon.

7/12/00
Date

Ritesh P. Shah
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